

XXIV. *Memoirs on various Species of Hymenopterous Insects.* By J. O. WESTWOOD, F.L.S., &c.

[Read 4th February and 3rd June, 1839.]

I. *On the Economy and Relations of the Genus Xiphydria.*

[THE various situations in which the genus *Xiphydria* was arranged in the classifications of Latreille, Jurine and Leach, together with its intimate relation with the genus *Sirex*, Linn., and consequent importance in the distribution of the *Hymenoptera* given by Mr. MacLeay in the "Horæ Entomologicæ," (in which the *Tenthredinidæ* are removed from the rest and united with the *Trichoptera*, and *Sirex* is made an osculant suborder under the name of *Bomboptera*,) induced me, about twenty years ago, minutely to examine the structure of the ovipositor and sting of the chief groups of the Linnæan *Hymenoptera*, as well as the preparatory stages of such species as presented themselves. And although the general results of these inquiries have been given to the Entomologist in my "Introduction to the Modern Classification of Insects," a considerable number of details and sketches still remain unpublished. The discovery by Mr. Cooper of the preparatory stages of the genus *Xiphydria* afforded a very important clue to the solution of the question of the relations of that genus, and I accordingly drew up an extended memoir, (noticed in the *Zoological Journal* for 1827,) in which the entire structure of the genus, in its perfect and preparatory states, was reviewed with reference to that of the adjacent groups, and in which the position of the genus was traced, through the writings of preceding authors, and the formation of the ovipositor throughout the *Hymenoptera* especially examined; the propriety of the general arrangements of the order investigated; the situation of the present genus therein discussed, and a plan of distribution of the order proposed. During the last eighteen years, however, the philosophical investigation of the order has made such rapid strides that much of what I had written is now rendered useless; I have therefore struck it out of my memoir, which is here confined to the details of the structure of the insect in its different states, and a comparison thereof with the allied genera.—*J. O. W.* 1845.]

By the kindness of my friend, Abraham Cooper, Esq., R.A., I am enabled to present my readers with a description of the larva of a species of the Hymenopterous genus *Xiphydria*, which will,

I think, enable us satisfactorily to determine the family to which the perfect insect is referable.

In the month of November, 1826, this gentleman discovered near Hornsey, Middlesex, several of these larvæ alive and buried in the solid part of a branch of willow, which was perforated and devoured in different directions in a manner similar to the operations of the goat moth (*Cossus ligniperda*). Pl. X. fig. 1, represents the larva in one of the burrows. It would appear that Linnæus was aware that the larvæ of his *Sirex Camelus* (which is also a species of the genus *Xiphydria*) feed upon wood;* although De Geer, (Hist. d. Ins. vol. i. p. 567,) being ignorant of the economy of *Urocerus gigas*, placed that insect, together with *U. juvenus* and *spectrum*, with the *Ichneumonidæ*, and supposed its larvæ had similar habits to those of that family;† as did also Geoffroy, who established the genus *Urocerus* several years before Linnæus published the twelfth edition of the "Systema Naturæ," wherein he called the same insects by the generic name of *Sirex*, which latter name must consequently be rejected.

Modern Entomologists however do not appear to be acquainted with the economy of the insect under description, for M. Le Pelletier de Saint Fargeau, in his Monograph on the *Tenthredinidæ*, tells us (Preface, p. 13) that he is neither acquainted himself with the larvæ of this genus nor of *Xyela* of Dalman, nor does he believe that they were at all known. Dr. Leach formed this genus and *Cephus* into his family *Xiphydriadæ*, and amongst its characters we find the following: "Larvæ with scaly feet, or at least not membranaceous."‡ This description I shall however prove will not at all apply to the larva of *Xiphydria*. Latreille, in his "Genera Crustaceorum, &c.," makes no mention of the larvæ of these two genera; but in the "Règne Animal"§ he forms of them a primary division of the *Tenthredinidæ*, and says, "Les larves vivent probablement dans l'intérieur des végétaux ou dans les vieux bois;" and in a late work he observes, without any expression of doubt, "Larves sans pattes membraneuses vivent dans l'intérieur des végétaux."|| Dr. Klug, in his Monograph on the German *Siricidæ*, in which the present group is included

* "Habitat in ligno antiquo corrupto."—Faun. Suec. No. 1576.

† "Je ne connois point leurs vers, ni le lieu où ils vivent, mais la longue carrière de la femelle fait assez connoître qu'ils doivent être obligés de pondre leurs œufs dans d'autres corps, à la manière des Ichneumons."

‡ Samouelle's Compend, p. 267.

§ Règne Animal, vol. iii. p. 459.

|| Familles Naturelles, p. 442.

under the generic name of *Hybonotus*, merely observes—"Metamorphosis ex parte nota; constat nempe larvam Siricum morem observare et Xylophagam esse—Noxa certe nulla, præsertim cum in arboribus, nonnisi putredine jam corruptis larvæ inhabitent"—without adding any description of the larva itself.*

The larva is a soft, cylindrical, white and fleshy grub, with a small head and twelve segments to the body. When at rest the head of the insect is nearly obscured by the first three segments of the body, which are larger than the others. (Pl. X. fig. 2, represents the larva at rest.) The head is placed much lower than usual, (thus resembling, as Mr. Cooper remarked, the position of the head of the perfect insect,) and is of a harder substance than the remainder of the body, and is furnished with a small upper lip rounded in front (labrum, Pl. X. fig. 9*b*); a pair of strong short upper jaws or mandibles, (fig. 9*cc*, and fig. 11,) each having three or four teeth; a pair of under jaws or maxillæ, which offer a rather remarkable peculiarity of structure, being composed of two parts, the inner (fig. 12 and 13*bb*) fleshy and rather hairy at the interior margin, and the outer portion (fig. 12, 13*aa*) not longer than the inner, but having the rudiments of several joints; there is also a large fleshy under lip (labium, fig. 9 and 12*e*), which does not appear to possess any appendage: the under jaws and the under lip are united at their base, and have one common motion. The rudiments of the antennæ (fig. 9*a*, and fig. 10) are placed a little above the base of the mandibles and are very short, and formed of several small rings gradually lessening in size to the tip. I have not been able to discover any vestige of the eyes of the perfect insect.

The first three joints of the body are, as I have before said, much larger and broader than the head or any other of the joints (except the last). They appear very much wrinkled on their upper side when the insect is at rest (see fig. 2), but when in motion these wrinkles become inflated and form a smooth surface (see fig. 3). The under side of each of these three joints is furnished with a pair of very minute fleshy legs (fig. 4 and 5), of which, when in motion, the insect makes but little use, generally laying upon its side bent, as at fig. 2. Its motion is performed by stretching out the first three joints and then drawing the remainder of the body after them, similar to the motion of a worm. The next eight segments of the body are very nearly equal in size, and are without any vestige of feet, each being furnished with a pair

* Monogr. Siric. Germ. p. 14.

of lateral raised fleshy tubercles of the same length as the joint itself, which have somewhat the appearance of a row of white coral beads in miniature along each side of the body of the insect (see fig. 2 and 3). The last joint is larger than any of the eight preceding and is singularly formed, being flattened above with several impressed lines upon its surface and rounded underneath. It is also furnished at the apex with a short spine, composed of several pieces of various lengths soldered together (fig. 8bbb) and arising from the centre of a coronet of very minute spines (fig. 8aa). Of the duration of the insect in the larva state I can give no account.

The economy therefore of this insect is not very dissimilar to that of *Urocerus*, the larvæ of which resides in burrows in the solid wood of the fir; Mr. Marsham, in the tenth volume of the "Linnæan Transactions," relating a lively anecdote of the alarm of a nurse and some children at the appearance of several specimens of *Urocerus gigas*, which came out of the deal floor of a newly boarded room.

But it is not in economy alone that this similarity is perceivable, for if we examine the figure of the larva of *Urocerus*, given in the eighteenth plate of the "Introduction to Entomology," or its description as given by Klug in his admirable Monograph on the genus *Urocerus*, we shall not be able to find any material difference. He describes it as being "Mollis, cylindrica; segmentis tredecim æqualibus, ultimo excepto majori rotundato, pluries plicato spina parva terminali parva instructa; capite subglobo, parvo, mandibulis exiguis armato; pedibus sex segmentis tribus prioribus infixis. Pupa folliculata, quiescens, imagini simillima alarum tantum rudimentis. Victus larvæ ex arborum ligno."*

With regard to the larvæ of other *Hymenoptera* the nearest approach to that of *Xiphydria* is made by the Tenthredinideous genus *Lyda*, the larva of which entirely loses the prolegs (although so peculiar a character of that family, but which nevertheless vary in number in the different genera). There is also another character which the larva of the *Uroceridæ* possess in common with those of the *Tenthredinidæ*, namely, that of having the rudiments of all the parts of the mouth of a mandibulated insect perfectly distinct, a character which no other Hymenopterous larvæ possess in so great a state of development. Nevertheless, as I have above stated, in the motion of the larvæ of *Xiphydria*, a considerable agreement is

* Monogr. Siric. German, p. 25.

perceived with the motions of the true Hymenopterous larvæ, which are more properly called vermiform. Looking, therefore, at the *Hymenoptera*, with reference only to the larvæ, we should say that they are primarily divisible into two great groups; the first comprising the *Tenthredinidæ* and *Uroceridæ*, and the second all the other *Hymenoptera*, the passage being formed by the *Uroceridæ*. But let us not forget that the state of the larva is only preparatory to that future state of which Mr. MacLeay has himself remarked, that “the true criterion of animal, as well as vegetable perfection, is the ability to continue the species;”* and Messrs. Kirby and Spence give it as their opinion, that a striking agreement in the perfect state, which is the acme of their nature, affords a much more satisfactory reason for keeping two tribes together, than any difference observable in their larvæ or metamorphosis for separating them.†

The pupa of this interesting insect decidedly belongs to the complete class of *Metamorphosis* in which the pupa is incomplete, being covered with a thin membraneous skin inclosing in separate and distinct sheaths the different organs of motion. Mr. Cooper found, on splitting a piece of the branch, several specimens in different stages of their pupa state (all, however, were dead): some being of a light brown colour and shrivelled up as though they had died immediately on assuming this state, (Pl. X. fig. 15,) and without having their future parts so distinctly perceivable; others in an intermediate state; and some nearly ready to assume their last state, and in which all the parts of the future insect had acquired their natural colour and consistency, being only covered with the thin and now transparent skin of the pupa (Pl. X. fig. 14). There were also several which had even become perfect insects found in the channels made by the larvæ, but which were also dead. I am not at all able to account for this circumstance, the larvæ being at the same time alive and healthy; for we cannot suppose that nature would thus suffer any of her creatures intentionally to perish without having attained their perfect state, and performed the very purposes of their existence. How long the pupa state continues I know not, nor at what period of the year the perfect insect is developed, although they have been taken in the month of June.

The pupa state is therefore exactly similar to that of all other *Hymenoptera*, and furnishes another proof that these insects ought not to be established into a distinct order as Mr. MacLeay proposes in his “*Horæ Entomologicæ*.”

* *Horæ Entomologicæ*, 446.

† Introduction to Entomology, vol. iv. p. 374.

The *Tenthredinidæ*, *Ichneumonidæ*, and also the genus *Urocerus*, form cocoons in which to pass the pupa state; but Mr. Cooper tells me he did not perceive any thing like a cocoon in which his pupæ had been inclosed.

In examining the structure of the perfect insect,* I shall not enter into a detail of the structure of their trophi, (although those of *Xiphydria* differ both from the *Tenthredinidæ* and *Urocerus*,†) as I consider that variations in the general external organization of an insect (being clearly indicative of variations in its economy and habits) are of greater consequence than variations in the structure of its mouth, the latter being in my opinion entirely dependent upon the former. Moreover, we know that not only do the genera which Latreille has included in the *Uroceridæ* differ very much in the formation of their trophi, (which that author has proved to be of a very anomalous character,) but that there is even very great difference in these organs in the species of *Urocerus* themselves.

The antennæ of the female of *X. dromedarius* have fifteen simple joints,‡ thus differing from the greater portion of the *Tenthredinidæ* and agreeing with those of *Urocerus*, which vary in number from thirteen to twenty-four,§ while *Oryssus* has only eleven. They also agree with *Urocerus* in the formation of the basal joints, and with *Oryssus* in having them much shorter than in *Urocerus*. In *Cephus* and *Lyda* there are nearly thirty joints.||

In the shape and insertion of the head *Xiphydria* also agrees with *Urocerus*; and if we examine the trunk or thorax of both genera we shall find little (if any) difference, the extraordinary elongation in *Xiphydria* of the manitrunk (which may here with propriety be called the neck) only excepted: but even in *Urocerus* this part is distinct (as in fact it is in all the *Hymenoptera*), and the fore feet are always attached to it.¶ Jurine (who has confused the

* Mr. Curtis has entirely omitted this anomalous genus in his work on the genera of British insects.

† The trophi of this genus and of *Xiphydria*, however, agree in being much shorter than in the *Tenthredinidæ*.

‡ Mr. Kirby (Mon. Ap. Angl. vol. i. 219) says that this species has thirteen joints in the antennæ. Might not this description have been drawn from a male? Jurine says the antennæ of this genus have from fourteen to twenty joints.

§ Kirby, loc. cit. (*Sirex*). Jurine (p. 76) says from nineteen to twenty-seven joints.

|| Jurine, pl. 7, fig. 1 and 3.

¶ This (the manitrunk of Messrs. Kirby and Spence) is an extremely interesting part of the insect, as it clearly shows the correctness of the ideas of those authors in considering this part, which in the *Hymenoptera* and *Diptera*, and one

subject a little by giving to *Xiphydria* the generic name of *Urocerus*, while to the insects which are alone entitled to that name he has given the synonymous name of *Sirex**) tells us that it is in consequence of the motion of which this neck is susceptible that two of the species have been named after the dromedary and camel.

The trunk (thorax) also of *Xiphydria* perfectly corresponds with that of *Urocerus*, while the wings, not only of these two genera but also of *Lyda* and *Cephus*, appear to be formed on the same plan, clearly proving that although possessing characters sufficiently different to form two distinct families, the *Tenthredinidæ* and *Uroceridæ* can never be forced into different orders. Again, in the form and proportions of the legs there is a complete resemblance between *Xiphydria* and *Urocerus*. I need only mention the shortness of the intermediate tibiæ, the smallness of the fourth joint of the tarsus, and more particularly the dilatation of the posterior tibiæ both in the males of *Xiphydria* and *Urocerus*, while in the Tenthredinideous genus *Cræsus* both sexes have the posterior legs dilated.

Let us now turn our attention to the structure of the organs of oviposition and the uses of the different parts. These organs consist of a pair of outer valves or scabbards (valvæ) and the ovipositor (terebra), which latter comprises the sheaths (vaginulæ) and the saws (terebellæ).†

tribe of the *Neuroptera*, is the true analogue of the upper and under sides of the (generally called) thorax of the beetles, as perfectly distinct from the collar in these orders, which latter part appears however to be wanting in the beetles. The under side of the manitrunk is called the antepectus by Mr. Kirby, (Kirby and Spence, vol. iii. p. 551,—prosternum Aud.,) and its sides turn upwards and nearly form a horny covering. Its upper side is formed of a ligamentous membrane, properly representing the pronotum of the beetles. Latreille (Hist. Nat. vol. xiii. p. 138) says, that this neck is formed by an elongation of the thighs (hanches) of the fore legs of *Xiphydria*. This is, however, quite erroneous, as on separating it from the trunk (which is very easily done) the fore legs are found attached to it; and on the under side, at its base, there are a pair of circular apertures forming sockets, in which the globose basal joint (coxa) of the fore legs may work backwards and forwards.

* Half the confusion in generic nomenclature has arisen from authors employing for new genera *synonymous* names of the genera from which their new groups have been dismembered. Surely when an Entomologist thinks it necessary to form a new genus he might give himself the additional trouble of finding a new name for it, retaining always the old generic name for the *typical* species of the old genus.

† There is also another character clearly proving that all these insects are formed upon a similar plan, namely, the existence of a pair of minute styliform

In all the insects of these families which I have examined there is a pair of outer crustaceous plates (scabbards or valves) differing in size in different genera, all formed alike and arising very near to the insertion of the true ovipositor, each valve being composed of two joints;* the first extending from the base to where the valve emerges from the abdomen and where the other joint (varying very much in length) is united to it by a membrane. These plates, which are of equal size, are concave in the inside for the reception of the ovipositor. In the *Tenthredinidæ* they are smooth and rather hairy at the apex, but in *Urocerus* they are scabrose. With regard to the use of these valves, Mr. Marsham, in the volume of the "Linnæan Transactions," has clearly proved that in *Ichneumon manifestator* they are only to be considered as the protectors of the ovipositor when at rest, and that they are not used in the great act of oviposition, but are thrown over the back and unemployed.

With regard to the ovipositor itself of the saw-flies (*Tenthredinidæ*), I cannot do better than give the following interesting extract from "Peck's Natural History of the Slug Worm," quoted by Kirby and Spence, (vol. iv. p. 154). He compares one of the saws and its sheath "with the tenon-saw used by cabinet-makers, which, being made of a very thin plate of steel, is fitted with a back to prevent its bending. This back is a piece of iron, in which a narrow and deep groove is cut to receive the plate, which is fixed; the saw of the *Tenthredo* is also furnished with a back, but the groove is in the plate and receives a prominent ridge of the back, which is not fixed, but permits the saw to slide forward and backward as it is thrown out or retracted. The saw of artificers," he adds, "is single, but that of the *Tenthredo* is double, and consists of two distinct saws with their backs. The insect in using them first throws out one, and, while it is returning, pushes forward the other, and this alternate motion is continued till the incision is effected, when the two saws, receding from each other, conduct the egg between them into its place. In the artificial saw the teeth are alternately bent towards the sides or out of the right line, in order that the fissure or kerf may be made sufficiently wide for the blade to move easily. To answer this purpose in some measure in that of the *Tenthredo*, the teeth are little twisted, so as

processes rising from each side of the last segment of the abdomen. They are to be seen in the *Tenthredinidæ* and *Ichneumonidæ*, and also in *Xiphydria* and *Urocerus*, although much more minute in these two genera.

* In *Oryssus* each is formed of three joints. (Latr. Gen. Crust. &c., vol. iii. p. 247.)

to stand obliquely with respect to the right line, and their point of course projects a little beyond the plane of the blade, without being laterally bent. And all those in each blade thus project a little outwards, but the kerf is more effectually made, and a free range procured for the saws by small teeth, placed on the outer side of each; so that, while their vertical effect is that of a saw, their lateral effect is that of a rasp. In the artificial saw the teeth all point outward (towards the end) and are simple; but in the saw of the *Tenthredo* they point inward or toward the handle, and their outer edge is beset with smaller teeth, which point outwards (towards the end)." Valisnieri, Reaumur, and De Geer describe the groove as being in the back; but in Mr. Peck's insect, if there is no error in his account, it is, as in the *Cicada*, in the saw itself. In the genus *Cimbex*, belonging to the same tribe, the saw differs in shape, being somewhat sigmoidal, or resembling the letter S, while in that of other saw-flies it is cultriform, with a concave edge: other minor differences distinguish them, which need not be particularized.

In *Cephus* the valves and the ovipositor itself are formed as in the *Tenthredinidæ*, except that the sheaths and the saws are not transversely striated; the connexion between each sheath and saw having the appearance of a longitudinal stria, and, in fact, beginning to assume somewhat of the horny appearance of the ovipositor of *Urocerus*, between which and the ovipositor of *Xiphydria* I cannot perceive the slightest difference of structure.

The last segment of the abdomen of the female of *Urocerus juvenicus* appears, when viewed on the under side, as though divided into two segments, the apical part having at its base an excavated spot, which Latreille* regards as the anus.

Notwithstanding, however, the differences which certainly exist in the formation of the organs inclosed in the bipartite scabbard and valves in the different families above referred to, I think, from the circumstance of the minute styliiform processes and the two external valves being similarly constructed in all these groups, we may without much difficulty trace the analogies of the other parts, (as has been attempted in detail in the 2d volume of my "Introduction to the Modern Classification of Insects.")

The manner in which the eggs are deposited by the ovipositor of the *Uroceridæ* and *Ichneumonidæ* does not appear to be ascertained, or whether the horny sides of the terebra are capable of extension on their under side. Messrs. Kirby and Spence observe upon the

* Genera Crust. vol. iii. p. 238.

ovipositor of *Pimpla*, (a genus of *Ichneumonidæ*, in which it is very long, exerted, and slender,) "How the egg is propelled, so as to pass in safety from the oviduct *along* this extended and very slender instrument to the grub for which it is destined, has not been certainly ascertained; but from an observation of Reaumur's, it should seem that it is aided in its passage by some fluid ejected at the same time with it, or is so lubricated as to slide easily without being displaced."* From these remarks, however, we might almost infer that it was supposed that the egg passed along the exterior surface of the terebra, but since in the *Tenthredinidæ* the eggs are conducted *between* the saws, I think there can be no doubt but that they are placed in such a similar situation in the abdomen of the female *Ichneumons*, &c. that they must pass within and between those organs which are analogous to the sheaths and saws of the *Tenthredinidæ*, and which have here become tubiform, and which, there is little doubt, have also the power of being opened and expanded on the under surface.

I do not intend to enter into a detail of the structure of the sting and ovipositor of the aculeate tribes, but shall only observe, that Latreille expressly says that the eggs do not pass through the former; † and that Messrs. Kirby and Spence describe the ovipositor as "the instrument of oviposition, being in some genera used as a weapon of defence, when it is called the *aculeus*;" ‡ and also they remark, that the stings of some *Hymenoptera* are analogous to the ovipositors of the majority of that order. § The manner in which the aculeate tribes deposit their eggs is, I believe, as yet, also unrecorded. || The plates, however, of Swammerdam may be consulted upon this subject by the student with great advantage, although this author was under the necessity of leaving the manner in which the eggs are excluded in doubt. ¶ (See his p. 205.)

I consider it therefore sufficiently proved that *Xiphodria* belongs

* Introd. vol. iv. p. 211. "Le tube ovipare de cette espèce (*Pimpla atrata*, F., the largest *Ichn.*, six inches long), est enveloppé d'une gaine élastique, dont les parois cèdent lorsque l'animal veut atteindre la chrysalide enfoncée dans quelque fente ou ouverture d'un arbre." Bull. Sc. Nat. Jan. 1828, p. 163, (Notes sur les *Ichneumons* en général, by Dalman, from the Swedish Trans. for 1825.)

† Gen. Crust. vol. iv. p. 51.

‡ Introd. vol. iii. p. 390.

§ Ibid. vol. iii. p. 717.

|| It may be worth noticing, that in a female of some *Bombus* which I took in copulâ, the sting was entirely protruded out of the abdomen.

¶ As however the structure of the sting is perfectly similar to that of the ovipositor of the *Ichneumons*, and as the egg in the latter passes down the ovipositor (see Lewis's papers in Mag. Nat. Hist.), it is agreeable to analogy that the eggs of the *Aculeata* pass down the sting.

to the family *Uroceridæ*; and if we recollect that Latreille admits into the family, without any expression of doubt, the genus *Oryssus*, which certainly differs from *Urocerus* in a much greater degree than *Xiphydria*, (although between the males of the latter genus and of *Oryssus* there is a very considerable resemblance,) I think there will remain little in favour of *Xiphydria* being placed at a distance from *Urocerus*, and as constituting a part of the family of the saw-flies, or as forming of itself the type of a separate family.

DESCRIPTION OF THE FIGURES.

Note.—The figures are more or less magnified, except where stated to the contrary.

Plate X. fig. 1. The larva making its way through the branch of willow, of the natural size.

2. The larva in the position in which it is generally at rest, and laying upon its side.
3. The larva stretched out, seen as when in motion.
4. The underside of the anterior segments of the larva, showing the position of the six feet.
5. One of the fleshy feet magnified.
6. The last segment of the body of the larva, upper side.
7. Do. under side.
8. Do. seen laterally; *aa*, the coronet of minute spines; *bbb*, the parts of which the apical spine is composed; *ccc*, portion of the segment.
9. The head of the larva seen from the front; *aa*, the rudiments of the antennæ; *b*, the upper lip; *cc*, the upper jaws; *dd*, the lower jaws; *e*, the lower lip.
10. The rudimental antenna, much magnified.
11. The upper jaw, do.
12. The lower jaws and lower lip of the larva; *aa*, the outer jointed part; *bb*, the ciliated interior part; *e*, the lip.
13. The lower jaw, more highly magnified.
14. A female pupa nearly ready to assume the perfect state.
15. A male pupa withered shortly after assuming that state.

P.S.—The parasitism of the genus *Urocerus* (*Sirex*), as suggested by the Baron de Geer, alluded to above,* has received another supposed confirmation in a memoir recently published by the Marquis Spinola, entitled “Considerazioni sopra i costumi degl’*Imenotteri* del *G. Sirex*, Fab. e sopra il miglior posto dei *Sireciti* nel metodo rationale;” † in which, after noticing the various

* The Count St. Fargeau (Encyc. Méth. t. x. p. 770, and Hist. Nat. Ins. Hym. t. i. p. 5, note 3,) has reaffirmed the parasitism of *Urocerus*.

† Genova, 1843. 8vo.

observations previously made on the economy of the genus, the author states that “nell’ estate del 1841, mi fu donato dal Signor Marchese Carlo Durazzo un insetto innominato col semplice iscrizione ‘Parasita in larva di *Farfalle,*’ con somma mia sorpresa reconobbi in esso una femmina del *Sirex gigas* ;” and on inquiring from Signor Franchi (from whom the insect had been obtained), he was informed that “la larva che ha dato recetto al parasita è quella del *Machaon*. Pero quando si sviluppò l’insetto, essa erasi da quindici giorni messi in crisalide ; si crede de poter anche asserire di aver veduto un *Sirex* uscire dalla crisalide del *Podalirius*.” From these remarks, and the statements of St. Fargeau, the Marquis arrives at the conclusion that “le larve dei *Sireci* sono zoofaghe,” proposing a classification of the order requisite for its distribution, in accordance to the supposed Zoophagous character of the *Sirecidæ*.

Having in the preceding pages endeavoured to prove the affinity of *Xiphydria* and the *Uroceri*, as well as to establish the Xylophagous character of the family formed of these two genera, I have deemed it necessary to notice the remarks of the Marquis Spinola cited above.

That the exuviae observed by the Count St. Fargeau lying at the side of the pupa of the *Urocerus* were those of the larva of some Longicorn beetle, upon which the *Urocerus* had parasitically subsisted, as considered by the Count, admits in my opinion of much doubt ; I consider in fact that they were the exuviae of the larva of the *Urocerus* itself. The structure of the head and manducatory organs of the latter in fact so closely resemble those of a Longicorn larva, that it is not surprising that the Count St. Fargeau should have mistaken them for the remains of the larva of a beetle which the *Urocerus* had devoured. It will of course follow that the finely pulverised particles of wood found in the burrows of these insects are the result of the boring of the *Urocerus* itself, and not of a larva upon which it has subsisted.

Neither can I consider the statement of the Marquis Spinola as more satisfactory in disproving the Xylophagous character of the *Uroceridæ*. The unsatisfactory mode in which the statement is made,—the very doubt of Signor Franchi, whether he had not obtained *Urocerus gigas* not only from *Papilio Machaon*, but also from *Papilio Podalirius*, (thus establishing a case of parasitism of one species upon two distinct species of animals, a circumstance of very unusual, if not of doubtful, occurrence,)—the well-known habits of the *Uroceri*, and of the two species of *Papilio* in question,

and the repeated opportunities offered by rearing the latter insects, as is so commonly practised abroad, and which have never hitherto afforded a case in support of such parasitism,—the totally different localities of the insects in question, the *Uroceridæ* inhabiting fir districts, and the *Papiliones* moist districts, where their favourite food occurs,—the many instances on record of the *Uroceridæ* being found in the larva state in the body of trees, where of course they could not be parasitic upon the *external feeding* larvæ of the two species of *Papilio* in question,—the impossibility of these larvæ being at one time internally parasitic on the larvæ of the *Papiliones* (as must have been the case with Signor Franchi's specimen), and externally parasitic on Xylophagous larvæ, feeding in the interior of trees, (like that of *Scolia*, observed by M. Passerini, which has also been assumed to be the case with the Urocerous larva,)—and lastly, but by no means of least importance, the structure of the mouth of the larvæ of the *Uroceridæ*, excellently adapted, from the formation of the mandibles, for feeding upon solid wood, but quite unlike those of any parasitic Hymenopterous larva,—are all circumstances which seem sufficiently to disprove the conclusion that “le larve dei *Sireci* sono zoofaghe.”

The genus *Cephus*, Latr. (*Trachelus*, Jur.; *Astutus*, Klug.) in various respects is one of great importance in regard to the relationships of the insects before us; and since the preceding memoir was written, several valuable observations have been made on its preparatory states, which throw considerable light upon its affinities, a circumstance of no little importance, when it is remembered that it has been arranged by the three great Entomologists, Leach, Klug, and Latreille, in as many different families, namely, the *Xiphidriadæ*, *Siricidæ*, and *Tenthredinidæ*.

The larva of *C. abdominalis* was observed by the late M. Audouin to be produced from eggs deposited in a spiral direction round the young shoots of the pear, the *larva feeding within the slender shoots*, and being fleshy, with six minute thoracic legs, but destitute of prolegs, and with the terminal segment of the abdomen attenuated, and terminated by two very minute points; there is also a minute conical lobe, near the base, on each side of this segment. This memoir has not yet been published.

A memoir on *Cephus pygmaeus* was however published by MM. Dugaigneau and De Tristan, in the Memoirs of the Société des Sciences, &c. d'Orleans, vol. i., in which the injuries committed by this insect upon the rye crops in France were detailed, and the insect described; and M. Dagonet, in a series of observations made in 1839 and 1840, published at Chalons in 1840 and 1841, has also

detailed the habits and structure of the same larva, (without being aware of its being that of the genus *Cephus*); and still more recently, an excellent memoir on the same insect has been published by M. Guérin Meneville, with ample details of the larvæ, which agree with those of *C. abdominalis* described above. It is apodal, or rather has the three thoracic segments furnished beneath with "des espèces de mamelons destinés à remplacer les pattes."* In its larva state it lives within the stems of the rye. Unfortunately M. Guérin Meneville had not discovered the pupa, but adds, "elle doit se métamorphoser dans la coque transparente que la larve se construit, et que nous avons représentée à côté de la figure de cette larve." In the description of the plates, however, he incorrectly describes the figure here referred to as the "Nymphé du *Cephus pygmæus* renfermée dans son tube," which has doubtless led Mr. Curtis, who has copied this figure, in his memoir recently published in the Transactions of the Royal Agricultural Society, to refigure this cocoon, and describe it as the true pupa of the *Cephus*.

2. *On the Proceedings of a Colony of Polistes gallica, introduced into my Garden at Hammersmith from the neighbourhood of Paris.*

ON the 9th July, 1837, Messrs. Audouin, Brullé, and myself, being engaged in an Entomological excursion in the woods round Sèvres, near Paris, discovered in the Parc de Belle Vue, upon a wall with a southern aspect, many nests of *Polistes gallica*, of different sizes, and generally a foot or two from the ground. They were attached to the wall by a small layer of the material of which they were composed, and a footstalk about one-sixth or one-fourth of an inch long, attached at the middle of the back of the layer of cells, which of course had a horizontal position. The day was rather overcast, and the wasps had not much activity. On one of the largest of the nests were seated about half a dozen wasps, one of which was a female, and the others workers. When approached they did not fly off, but ran about the surface of the nest with their heads up, in a menacing position, seeming to defend it, like the great ants when their ant-hill is disturbed. On one nest, containing seventeen cells (some only just commenced), was one female and two workers, which we secured with our forceps. Another larger nest I brought away, having removed its attendant wasps.

* Notice sur quelques Insectes nuisibles. Paris, 1843, p. 39.

These I put into my box, and in a few days some more neuters were produced. These I lapped up alive in paper with the nest, and brought to Hammersmith. I now kept them some days in a tumbler, giving them sugar and honey to eat, which they seemed to relish, as well as the young grubs in some of the cells. I subsequently took off the gauze covering of the tumbler, and placed it in the open air, to see the proceedings of the insects. The day was very hot, and for some time they were occupied in vibrating their wings whilst standing on the top of the nest, and elevating the head and front of their bodies; at length they ventured to take wing, and I was anxious to ascertain in what manner these insects (now for the first time let loose) would proceed so as to obtain a knowledge of the neighbourhood, and thereby be enabled to retrace their steps. There were five wasps, and their proceedings were alike. After quitting the glass they made a very small circuit round it, then another rather larger, and so by degrees till the diameter of the circle was not less than a yard. They then alighted on the leaves of the adjoining trees, and seemed much delighted to bask in the sun. They returned from time to time to the glass, and in the afternoon four out of the five returned. I then brought the glass into the house for the night, putting it out again the first thing on the next morning, when the missing wasp immediately made its appearance, hovering over the glass. I noticed at first that they passed the night with their bodies entirely immersed in the cells, but afterwards they congregated on the top of the gauze covering. In a few days I put the glass out of doors, when the wasps did not return to it regularly, but left it one by one. A little rain got into the glass one evening (notwithstanding I had put a cover over it), and melted the sugar, which attracted the ants and earwigs, (the wasps being all absent,) which devoured not only the sugar, but also the grubs. On Friday, 28th July, afternoon, the nest was deserted. Saturday was a wet and boisterous day, and the wasps did not return. Sunday, ditto. Monday was a fine day, and three of the wasps returned early in the morning, but of course found the nest without grubs. Some ants were in the glass, and occasionally one found its way upon the nest, when they were assaulted by the wasps. The mode of attack of the latter was singular; they appeared irritated, raised the front part of the body, made a dash at the ant with the jaws, and instantaneously jirked the intruder over their backs, without either stinging or killing it.

The spiracles of the larva, according to M. Audouin's observations and figures (MS. Obs. 1835, No. 23, inedit.), are placed only on the meso- and meta- thorax and first abdominal segment, a pecu-

liarity requisite from the dilated front of the body, which fills up the cell, and prevents access of air to the hind part of the body.

The flight of these wasps is very peculiar, and quite unlike that of the *Odyneri* or *Vespæ*. The long hind legs are extended backwards and downwards, reminding one of the flight of *Fænus*. There is a species of *Tenthredo* very nearly allied to *T. scrophulariæ*, which I saw on the wing in September following, and which exactly reminds one of the flight of the *Polistes*.

P.S.—The preceding details offer abundant suggestions in support of the opinion, that it is principally by means of sight that insects, especially of the social species, are directed in their flights, and thereby enabled to retrace their steps to the hive or other dwelling place, and which has been maintained by Mr. Newport in a preceding page of the present volume. The cautious proceedings of my colony of wasps clearly indicated a gradual increase of knowledge of immediately contiguous objects; but can we suppose it possible that the same kind of knowledge is obtained by the bee in a direct flight of several miles from its hive, especially at a time whilst all its attention and energies are devoted to the great business of its life, that of hunting for and pillaging flowers?

I shall here mention, in support of the power assumed to be possessed by insects, of obtaining knowledge by means of sight, a circumstance which I observed many years ago in Fleet Street, and which, although it indicates an error of sense, seems more completely to establish the one in question than perhaps any previously recorded fact. On a bright sunny day I observed a white butterfly beating itself with violence against the outside of the panes of glass in a window on the north side of the street, on which the sun was shining with great force; at first I could not comprehend what could induce this action in the butterfly, but the mystery was solved when, on looking into the window, I observed the many gaily coloured labels of a chemist's jars and packets placed on the opposite side of the glass. This had doubtless been mistaken by the butterfly for flowers, which it endeavoured to reach in order to rob them of their sweets; of which of course the insect could have obtained no intimation by its sense of smell. How is it possible, with such facts as these before us, to adopt the conclusion of a work recently published, that insects are destitute of the senses? How is it possible to arrive at so unphilosophical a conclusion, that the highly organized eye of an insect does not possess the sense of sight?

3. Some account of the Habits of a new Species of fossorial Hymenopterous Insect from South Australia. By J. O. WESTWOOD.

[Read 3d January, 1842.]

THE various modes employed by the nidificating aculeated *Hymenoptera*, in the construction of their nests, and the adaptation of their structure to the purposes of their economy, in this respect afford materials for observations of the most interesting as well as instructive kind; interesting, from the singularity of the manœuvres and assiduity of the insects; and instructive, from furnishing us with complete details of the history of particular species, thereby confirming, in the most satisfactory manner, their relations with other species. The nest-making *Aculeatæ* may be divided into several distinct groups, from the mode of construction of their nests. Not to speak of the social kinds, which form beautiful structures composed of series of hexagonal cells, or of the social humble bees, we find the solitary nidificating species again divided into such as merely content themselves with making a burrow in rotten wood, or in a sand-bank, in which they bury a caterpillar, or other insect or spider, and those which fetch the materials of their nests from a distance, which they then either employ as a lining to their burrows, or else form into an exposed nest, without previously forming any burrow.

In our own country I believe no fossorial species exists which forms exposed nests, all the species (except the parasitic ones) possessing an economy, which is indicated by their name of *Fossores*. Some of the species, indeed, as well as some of the wasps and bees, fetch materials from a distance to line their cells, already formed in burrows; a few of the bees however (such as *Megachile muraria*) form naked nests on the surface of walls, &c. The exotic genus *Pelopæus* is the only recorded instance of a fossorial insect making an external nest.

The nests which, with their inhabitants, form the subject of the present communication, were brought from Port Lincoln, South Australia, but unaccompanied by any details. They are however evidently nests formed externally, in the same manner as the nests of the *Megachile muraria*. They came to me in several masses, each consisting of two or three cells; each cell is about an inch long, and half an inch in diameter; they are smooth on the inner surface, and the case is about the thickness of the shell of a hazel nut, with the outer surface very rugose, as though formed of a succession of short transverse layers, which have dried into rounded

or elongated nodules. The substance of which they are composed is evidently earthy, as it will not burn, but retains its form when thrown into the fire.

On opening these cells I found in each a delicate white slender membranous sac, affixed by its base to the bottom of each cell, the upper end being free, and generally open, the insect having made its escape; on the outside of this membranous bag I found in several of the cells portions of the chelicerae of a large species of spider, which had evidently been devoured by the inhabitant of the cell whilst in the larva state, and previous to the formation of the membranous sac. Within one of these sacs I found a dead larva, represented in Pl. X. fig. 18, not differing in its structure from the larva of other fossorial species; whilst in each of two other of the sacs I found the dead pupa of the insect, which I at first mistook for an *Ichneumon*, from the great length of the antennae, and the slenderness of the body. These pupae were almost arrived at the perfect state, so that, with the exception of the wings, all the parts could be distinctly traced, as well as the colours of the future imago. The antennae are laid along the sides of the breast, and are long and slender, extending rather beyond the posterior coxae, and consist of thirteen joints, thus indicating the specimens to be males. The basal joint is robust, the second very short, and the remainder slender, and rather elongated. The fore wing, when moistened with water, and placed under the microscope, was seen to have two deep folds on the costa, whereby its length was reduced nearly one-half. The most peculiar feature was the large square prothorax, resembling that of the genus *Aporus*, and of various exotic *Pompili*; it is, in fact, by the structure of this part of the thorax, which is employed amongst the fossorial *Hymenoptera* as a primary distinctive character of the several families, that we are enabled to determine the natural relations of this insect. The entire body is black, and clothed with a very slight griseous pubescence. The antennae are white, and the tibiae and tarsi brownish white. The abdomen is slender, and composed of seven segments; at first the dorsal portion of the abdomen appeared to have the segments posteriorly margined with grey bands, but I found this to result entirely from the pellicle of the pupa having been scaled off from the base of each segment.

The strength of the founder of these nests may be imagined from the fact, that the single jaw of the spider found in one of the cells was as large as the entire head and prothorax of the perfect insect. The combat between the parent fossor and its prey must therefore

